taken of the contribution of multiple photons to the shape of the experimental spectrum.

Figure 2 shows the dependence of the total number of photons per electron on the distance b between foils in the range 5 - 20 keV. It follows from the figure that at low values of b the number of quanta increases strongly with increasing b. The growth then slows down and the curve becomes practically flat at $b \gtrsim 700\ \mu$. This is attributed to the influence of the zone where the radiation is formed in vacuum, $z_{vac} = c\gamma^2/\omega$ [4], where $\gamma = E/mc^2$ is the Lorentz factor of the radiating particle. An estimate yields for the indicated interval $z_{vac} \sim 700\ \mu$, which is in good agreement with the experimental curve. We can thus conclude that the interference between the plates in the stack at $b < z_{vac}$ leads to suppression of the transition radiation.

In conclusion, the authors thank A. I. Alikhanyan for interest in the work, A. Ts. Amatuni and S. G. Matinyan for constant support, and G. M. Garibyan for a useful discussion.

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EXCHANGE NARROWING OF EPR LINES OF YTTRIUM AND GADOLINIUM IRON GARNETS NEAR THE CURIE POINT

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The critical exponents of the temperature dependences of the EPR line widths of yttrium and gadolinium iron garnets near the Curie points have been determined for the first time.

Studies of the dynamic characteristics of magnetic phase transitions have become particularly important recently. The results of a number of studies of electron paramagnetic resonance (EPR) of antiferromagnets near the Neel point (see, e.g., [1 - 3] and elsewhere) and of determinations of the dynamic critical exponents yield interesting information on the nonequilibrium behavior of a magnetic system near the critical point, and on the validity of various theoretical models of phase transitions. It is undoubtedly of great interest to perform similar investigations on ferro- and ferrimagnets. There are, however, no published data on the behavior of the EPR parameters of these substances near the Curie point (Θ).

We have investigated the temperature dependence of the EPR line width (ΔH) and of the g-factors of yttrium and gadolinium iron garnets (YIG and GIG) when the Curie point is approached from the high-temperature side.

The temperature dependence of ΔH of iron garnets near Θ can be represented in the form

$$\Delta H \sim (T - \Theta)^n \qquad (1)$$

Calculation of the temperature dependence of ΔH of ferromagnets in the paramagnetic region with the aid of the method of moments using the random-phase approximation [4] leads to an exchange narrowing of the EPR lines like $(T - \Theta)^{1/4}$ as Θ is appreached.

Figures 1 and 2 show plots of ΔH (where ΔH is the width of the resonance line at half the maximum absorption) against the difference $(T - \Theta)$ for single-crystal YIG and GIG samples, respectively, plotted in a logarithmic scale. The measurements were made with a commercial

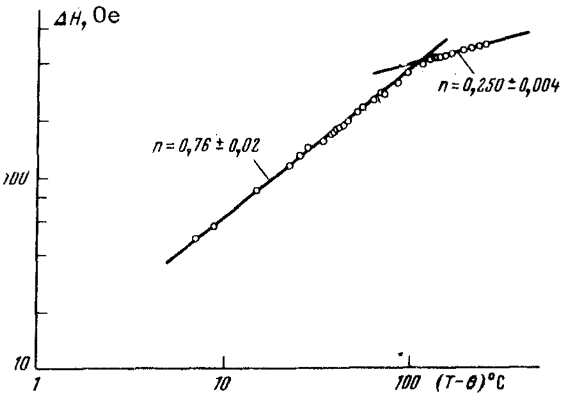

Fig. 1

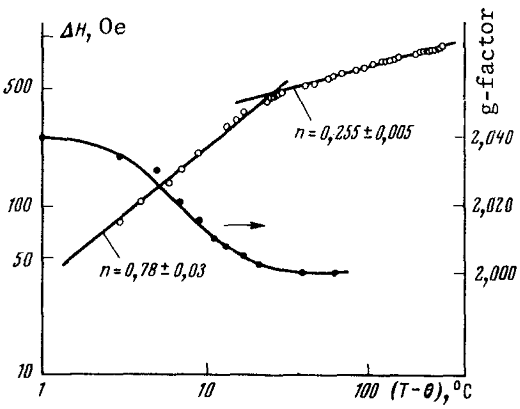

Fig. 2

Fig. 1. Temperature dependence of ΔH of YIG.

Fig. 2. Temperature dependence of ΔH and of the g-factor of GIG near the Curie point.

(RE 1301) radio spectrometer at a frequency ∿9600 MHz. The EPR lines of the investigated samples had a Lorentz shape, as is typical of an exchange-narrowed magnetic-resonance line. The temperature Θ was taken to be that at the intercept of the ΔH(T) curve with the abscissa axis (the shape of this curve is given in [5]). The values of Θ of YIG and GIG were 554 ± 1°K and 562 ± 1°K, respectively.

It is seen from the figures that starting with a certain temperature the exponent in (1) agrees with good accuracy with the predicted value 1/4. According to [4], however, one should expect in the immediate vicinity of Θ considerable deviations from $n = 1/4$, owing to the influence of the external magnetic field in which the resonance measurements are made. It is seen from Figs. 1 and 2 that as Θ is approached, starting with 105 ± 10°K for YIG and 22 ± 2°K for GIG, n takes on the value 3/4. The values of n were calculated by least squares with the "Nairi-2" computer.

On going through the Curie point, an abrupt change was observed in the g-factors of the iron garnets. Figure 2 shows a plot of the g-factor of GIG near Θ. The g-factor of YIG in the critical region of the phase transition is given in [5]. Below the Curie point, in the ordered phase, the resonance field is determined by a certain effective g_{eff}, which is a function of the g-factors of the individual sublattices and their magnetic moments. Much above Θ, in the paramagnetic region, the resonance field is determined by the g-factor of the individual spins that participate in the resonance. The presence of a magnetic field as well as the intense paraprocess near Θ, which is particularly large in YIG [6], is the apparent reason why regions with strictly correlated spin directions still remain in a certain temperature range above Θ. In other words, the external field leads to a transition state in which regions with ordered phase appear in addition to the paramagnetism.

The width ΔT_{tr} of the temperature interval in which the change of the g-factor takes place differs for the different iron garnets, being about 100° for YIG and 20° for GIG. It should be noted that deviations of the exponent in (1) from 1/4 are observed for these samples in the same temperature interval.

The presence of regions with an ordered spin system and the interaction of the magnetic moments of such systems with one another and with the surrounding matrix lead, when Θ is approached from the high-temperature side, to an appreciable exchange narrowing of ΔH at temperatures farther from Θ than assumed by the $n = 1/4$ law. The presence of this region will undoubtedly explain also the deviation of the g-factors of the iron garnets both from the paramagnetic and from the ferromagnetic values. One can speak of a paramagnetic state only at temperatures higher than $\Theta + \Delta T_{tr}$.

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DYNAMIC PHASE STRATIFICATION AND GENERATION OF ELECTROMAGNETIC WAVES IN THIN CURRENT-CARRYING SUPERCONDUCTING FILMS

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We have observed in [1] generation of electromagnetic waves by thin current-carrying tin films in the resistive state. In the present paper we report investigations of the current-voltage characteristics (CVC) of thin films, which may explain the generation mechanism.

We investigated films similar to those in [1] with respect to the preparation technology and dimensions. They were connected in a resonant circuit tunable from 30 to 230 MHz and the CVC and the amplitudes and frequencies of the generated oscillations were recorded simultaneously. The CVC of the films and the amplitudes of the generated oscillations had forms similar to those in [1]. No hysteresis was observed on the CVC at the point corresponding to generation at a given frequency. The agreement between the experimental temperature dependence of the critical current j_c with the Ginzburg-Landau theory [2] was checked for the investigated films.

Figure 1 shows the experimental temperature dependences of the current j_g at which a given frequency is generated, and the differential resistance $R_g = du/dj$ at the generation point. For convenience in comparison with the critical current, the ordinates represent the values of $j_g^{2/3}$ and the abscissas the values of $t = T/T_c$, where T_c is the critical temperature of the sample. Figure 2 shows the experimental frequency dependence of R_g, at which the given frequency is generated at a constant temperature. The presented experimental relations lead to the following conclusions:

1) A given frequency is generated at different temperatures with one and the same value of the relative current j_g/j_c, since the temperature dependences of j_g and j_c are identical [2]. Thus, the law of corresponding current states is satisfied for the frequency of the generated oscillations. At a fixed temperature, larger currents correspond to higher frequencies.

2) At different temperatures, a given generation frequency corresponds to a definite constant value of the differential resistance of the film. The differential resistance R_g is constant if the law of corresponding current states is satisfied.

3) At a fixed temperature, higher frequencies are generated at the CVC points corresponding to larger values of R_g. The relation between f and R_g is linear in the investigated frequency range.

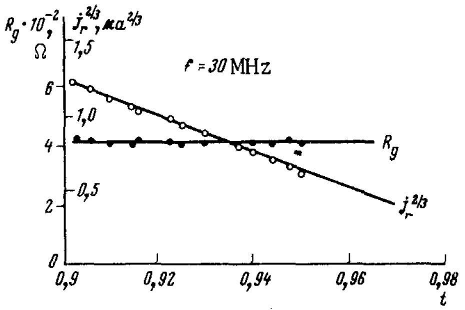

Fig. 1

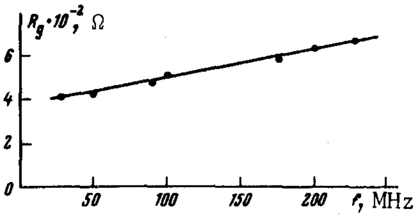

Fig. 2